WESTERN UPDATE #74 July 12, 1990

THE WESTERN NEWSLETTER FOR MF, LF, AND VLF EXPERIMENTERS

Available for business-size 25 cent SASE's, plus $1 per issue (or $10 per year)
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ACTIVE EXPERIMENTAL BEACON STATUS (LIST COMPILED JULY 12, 1990)

FREQ(kHz)	IDENT	LOCATION	SCHEDULE INFORMATION
166.503	C	Near Morro Bay, CA	24h/7d.
169.94	NRE	San Diego, CA	24h/7d.
175.275	**X**	**Wheatland, WY**	**24h/7d 10 baud CW. NEW! Max Carter.**
175.703	FAW	Orem, UT	24h/7d.
176.0	HDO	Morro Bay, CA	24h/7d.
176.26	CO	Glenwood Springs, CO	Temporarily off.
176.85	7FS	Belfair, WA	24h/7d.
177.75	CT	Pleasant Gap, PA	10 baud BPSK. Status unknown.
178.62	DJ	Los Banos, CA	24h/7d.
179.54	WJ	Arleta, CA	On, but intermittent.
180.224	F	Los Banos, CA	FSK. By request.
181.17	IZJ	San Gabriel, CA	Daily. Silent 0700 to 1100 UTC.
182.672	**G**	**Palo Alto, CA**	**Temporarily off.**
182.88	**H2**	**Descanso, CA**	**24h/7d, with occasional outage.**
183.160	PRK	Saratoga, CA	24h/7d. Dan Smith K6PRK.
183.544	MEL	San Jose, CA	24h/7d.
184.016	EK	Sunnyvale, CA	24h/7d.
184.39	HO	Pahoa, HI	By request (Sheldon Remington).
184.43	**V**	**Sebastapol, CA**	**24h/7d. Jim Pelmulder N6PTM. NEW!**
184.46	MGX	Fresno, CA	24h/7d.
184.5	TEXAS	NW of Ft. Worth, TX	24h/7d.
185.0	ZYK	Redway, CA	24h/7d.
185.02	**ZI**	**San Jose, CA**	**24h/7d. QSY. Frank Butscher W6SZS.**
186.375	**BA**	**Lancaster, IL**	**24h/7d. Note slight QSY.**
187.2	CAT	Cincinatti, OH	24h/7d.
187.50	DCH	Berlin, MD	Schedule unknown.
187.59	SM	San Jose, CA	Schedule unknown.
187.7	3 GOATS	Portland, OR	24h/7d.
187.77	AZ	Tucson, AZ	24h/7d. Often silent 0400 to 0530 UTC.
190.4	OHH	Richmond Hill, Canada	Occasional testing.
513.67	**SD**	**Descanso, CA**	**24h/7d. Note QSY. Frank Cathell.**
1624.75	CT	Pleasant Gap, PA	24h/7d. 5 baud CCW. Clint Turner.
1631.54	A	Cleveland, N.C.	24h/7d. Ron Barlow.
1637.93	RR	San Rafael, CA	Sunset to Sunrise. Steve McGreevy.
1648.5	ABC	Hilton Head, S.C.	24h/7d. Todd Roberts.
1650.62	G4	Palo Alto, CA	24h/7d. Herb Vanderbeek.
1654.7	EK	Sunnyvale, CA	24h/7d. Jim Ericson.
1655.2	CO	Glenwood Springs, CO	Off temporarily. Bob Cutter.
1661.35	U	San Diego, CA	Nights only. Steve Meyerpeter, KG6BY
1665.2	**G5**	**Palo Alto, CA vicinity**	**Most nites. Mobile! NEW! Herb V.**
1671.8	WJ	Arleta, CA	24h/7d. W6SZQ Wallie Jones.
1688.2	TUS	Tucson, AZ	KD7QK. 0000 to 1400 UTC daily.
1688.45	Z2	9 Mi. NW San Simeon, CA	Mike Mideke. By request.
1689.1	AZ	Tucson, AZ	Greg Farkas. 0000 to 1400 UTC daily.

5 MORE SASES ON FILE

Note: FPV, PLI, and ELU have an active SSB/Amtor (live QSO's) net in Southern California on Saturdays around 10 A.M., and Wednesday nights about 7:30 P.M. between 183 and 186 kHz.

Non-Western listings are beacons currently being copied in the West, or they have SASE's on file with us.
Bold entries indicate recent changes, or new beacons.

EK NOTES/MAILBAG: In spite of the fact that the majority of active experimenters seem to have a lot of changes going on in their lives (new jobs, house renovation projects, travel, etc.) we continue to get some pretty significant contributions to the newsletter. Thanks especially to **Ed Phillips** for the excellent treatise on variometer design in this issue. Also to **Dave Johnson (of Los Banos, CA)** for his ideas on "signal grabbing", **Todd Roberts** for a crisp two-pager on some fine experimental work with MedFER radial systems, and **Mike Mideke** for his status report from the mountains above San Simeon, CA.

New subscriber **Bob Confrey** (WA1EDJ/4) writes, "I hope to have a MedFER beacon on the air in a month or so on 1645 kHz. The IDer is built, and the exciter is working. I need to get some kind of antenna built and get it all tuned up. The ID will be **'DE EDJ STONE MOUNTAIN, GA'**. I am listening for MedFER beacons on a 40 meter dipole and I haven't had any luck at all. **A** and **ABC** are the closest beacons, and I haven't heard anything as yet. Will keep trying. We are not as lucky to have so many beacons as the West Coast bunch but perhaps I can add one more to the small group in the Southeast US."

Faithful Illinois experimenter **Brice Anderson (BA)** reports, "A tornado tore into Lancaster on May 9, missing my yard by about a block. I was fortunate, and lost no antennas. **BA** is still on. I hope to have a MF beacon on in a few weeks. **YHO** lost his LF vertical in storms. I haven't heard **9HDQ** for several weeks and fear that he may have lost his antennas. **CAT** was able to save his antenna with new guy ropes. I had to remove all of my above-the-ground radials to permit mowing every five days. **BA** is on with about 1000 feet of buried radials and two ground rods. Our record rainfalls have made the grass grow like crazy!"

Dave Curry (PLI of Burbank, CA) wrote to say that, "LowFER activity this spring and winter in the Southern Cal area has been very steady. Regular use of 1750 M by the local net, which at this moment consists of **Randy Seden (ELU)**, **Charles Faulkner (FPV)**, and myself, is proving extremely reliable and almost predictable. Gone are those days of counting how many neon lights seem to glow, or wondering if watering the ground system will suddenly make bulb #10 suddenly illuminate, indicating we've reached a full block further! The Southern Cal net is looking forward to having a friend join us on the band by the name of **Dave Zumwalt**, who lives near Lancaster (high desert, just north of Los Angeles). He will be operating SSB like the rest of us, but lives far enough away that the true 1750M challenge might be expected." On another subject, Dave notes, "Perhaps you did not know this but I have an article in the June issue of 73 Magazine describing one of the kits that I sell, and Jim, it is surprising the feedback that I have received since then! There really are a lot of interested people who want to be involved in some way with low-frequency experimenting and/or listening. Your Update is mentioned in all kit orders and brochures that I have been distributing on a regular basis." Dave has a bunch of very nice kits for the hobbyist. His current brochure lists a 1750 M transceiver, a receiving processor, a 1750 M transverter, a synchronous noise blanker, LF/VLF variometer, and a 1750 M upconverter. Write him for a free copy c/o Curry Communications, 852 North Lima Street, Burbank, CA 91505.

Dave Johnson (WA4NID of Florida) sent a subscription renewal check and a note that went, "Thanks $x10^6$ for great job on a nice rag! Hopefully I'll get done workin' on my PhD by December, then move to a place where I can put up a better antenna. for now, we have two Florida beacons (reported up and running as of early June). **Jerry's (K4UBR)** beacon **GG** in Middleburg on 188.8 kHz, and **Jim's (N4KIM) ONF** beacon in the region of Ocala on 171.1 kHz. **ONF** = Ocala National Forest. I had helped Jerry just a bit to get the Xmtr going, but most credit goes to him , for antenna and installation. Jerry and Jim worked up a circuit for an EPROM beacon keyer which they will describe in a future Northern Observer article. Best wishes,keep on truckin', and have fun with radio!" Thanks Dave, and thanks for the reminder to plug the other Experimenter Newsletter, The Northern Observer. It is published on the same basis as Western Update by **Herb Balfour** in Canada. It covers Canada, the Midwest and Eastern part of the USA. Herb and I share info as editors, but we do not always publish the same stuff. Interested experimenters should subscribe to both! The Northern Observer is available for an annual $15 fee (USA money) plus 12 self-addressed business-size envelopes. Note that the Observer is a bit more expensive than the Western Update...simply because Herb has to affix Canadian postage (for some funny reason, they don't like USA stamps!).

Greg Garcia (WB6DAI of San Francisco) is a native San Franciscan and has had a long-term interest in antenna design. Greg says, "I was a friend of **Art W6TYP** and **Bob W6EAJ**. In the early 80's I worked at SRI International with over-the-horizon radar and study of the Luxemborg effect on HF." Greg sounds like he is putting some equipment together, and is rekindling his interest in QRP portable gear and CW.

Sheldon Remington of Hawaii writes to report that he has temporarily abandoned frequencies below 40 MHz, and that his NDB Newsletter has gone into hibernation. He is deeply involved with 6 Meter DXing, but since 6 Meters is really interesting only near the peak of each 11- year solar cycle, he expects to return eventually to Longwave. Sheldon comments, "...As for transmitting (under Part 15), I have never had much interest in it, given the FCC-mandated limits. I feel strongly that the failure of 1750 Meter activists lobbying the ARRL and FCC to get a full-fledged ham band allocated at WARC will force 1750M to remain stagnant. Another WARC is upcoming. Thus, another golden opportunity, but nobody in the LowFER community seems to give a hoot. The thing I like best about amateur radio is its potential for scientific achievement, but such an achievement I feel, will never be forthcoming as long as LowFER's are content to operate flea-power under Part 15." This might sound like an off-the-wall comment, unless you know that Sheldon is the holder of the world's record for DX reception on the LowFER, MedFER, and the NDB bands! Incidentally, Sheldon asks that we mention the fact that he continuously monitors 28.885 MHz USB (the global 6M liaison frequency) and would be happy to chat with anyone in the Part 15 community. Any comments on Sheldon's position?

Allan Egleston is jumping into amateur ratio "both feet first". He has connected with a Novice training class, and is also very interested in LowFER activity. He reminds readers about **George Trinkaus** fine Tesla publications. George publishes several soft-cover books about Tesla and Tesla coils. Write High Voltage Press, 4326 S.E. Woodstock #489, Portland, Oregon, 97206. George is a subscriber to the WU (and joined us for the recent campout!). His publications are very high-class, and if he will send us info, we will be happy to make mention of them in a future Update!

Late News! **Max Carter** of Wyoming has a beacon back on sending a 10 baud CW **X** on 175.275 kHz. Max says, "Let's hope it stays up for awhile!" Via **Mike Mikeke, Keith Olson 7FS** reports daily good copy on **3GOATS**, although there is lots of signal variability. **Mike Mideke** (Z2 San Simeon, CA) is copying **Herb Vanderbeek's new G5 mobile Medfer beacon** on 1665.2 kHz. Herb will be running **G5** most nights for awhile. The Ant is a 9' whip on his Broncho truck parked in the driveway! Is this a first??

Out of space for this issue! Thanks for the material...keep it coming, and have a fine summer. 73 de **Jim Ericson (EK)**.

NEWS FROM Z2: by Mike Mideke, San Simeon, CA. Ranch work here has occupied most waking hours for the past few months, but even so LF and VLF projects have been inching forward.

MONITORING NOTES: For over a year I've had good nighttime reception of Frank Cathell's SD beacon on 1687.4 kHz at a distance of about 300 miles. When Frank moved the beacon to 513.67 kHz I followed with my receiver and had only a little difficulty in copying him, though the signal is much weaker and QRN seems to be quite a bit stronger than above 1600 kHz. Above 1600 kHz the SD signal was generally adequate for comfortable CW communication. On 513 the signal is marginal CW quality. Frank's H2 LowFER on 182.88 kHz has been completely obliterated by QRN at night since about mid-April. During the days, neither MedFER has been heard but the LowFER groundwave continues to be excellent copy. Western MedFERS above 1600 kHz remain good nighttime copy.

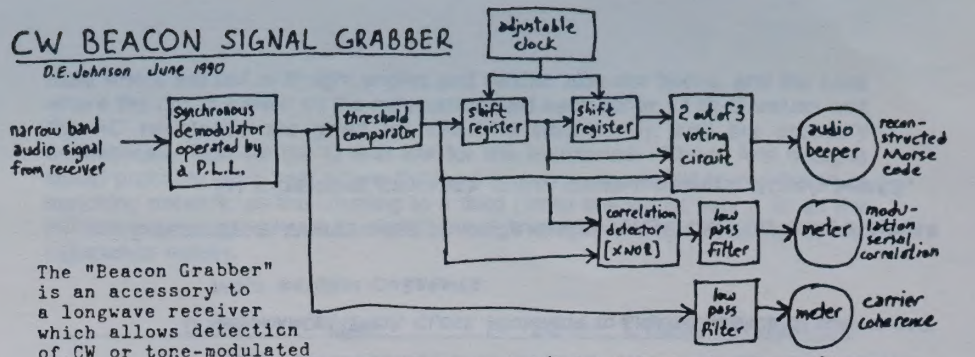
GROUNDWAVE: The predictable mainstay of LF communications seems to be subject to substantial variations. Since April I've been making regular daytime observations of several NDB's and LowFERS at distances of 17 to 230 miles. Beyond about 80 miles all signals are subject to shifts of several dB; Different for different directions but often very similar for signals arriving from the same general area. The observed fluctuations in signal strength are too great and too diverse to be readily explained by changes in the receiving system. Transmitter site factors probably account for some variations (for instance, rain makes a difference). But there remains a residue of data that may reflect varying path characteristics. A few monitors in other locations, even making only one or two observations a week, could help enormously in clarifying what this is all about. Any volunteers?

PROJECT ACTIVE: NASA cut its connection with operations of the Soviet VLF satellite ACTIVE on June 30th. The last 10.5 kHz transmissions in the western hemisphere were on June 27. As during the many schedules over the past seven months, nothing was heard at any of the ground stations -- no VLF signal, no triggered emissions. Evidently the transmitting loop's unfortunate deployment in a figure-8 configuration prevented coupling enough VLF energy to magnetospheric plasma for the triggering of emissions. Many hours of recordings were made from several North American ground stations including mine, and it may be that sophisticated weak signal analysis techniques will yet reveal traces of the satellite transmissions. Even if this is unsuccessful, the recordings have captured a number of natural VLF events, some of which appear to be quite unusual. Without ACTIVE, the monitoring that caught them would not have happened and our records of VLF phenomena around this solar peak would have some unsuspected blanks. ACTIVE monitoring was a cooperative effort which included the participation of amateurs, high school physics classes, NASA, the Soviet space agency IKI, and Stanford University. Special thanks are in order to Dr. Bill Taylor of TRW, Jim Ericson, Cliff Buttschardt, Frank Wyatt, and Stanford's STARLab staff for their support of my ACTIVE monitoring efforts, which would have been impossible without their help.

FUTURE VLF PROJECTS: Two additional "VLF from space" experiments are tentatively scheduled for 1991. The project APEX managed by the Soviets will launch a satellite similar to ACTIVE, but will equip it with a VLF-modulated electron beam accelerator. When fired into the ionosphere, this arrangement provides its own "virtual antenna." Whether NASA and Stanford will participate is yet to be determined. Also in 1991 NASA plans a similar electron beam VLF accelerator aboard the scheduled Space Shuttle "Atlas" mission. LF experimenters interested in working these should contact me right away and I'll do my best to facilitate your participation in the experiments. Useful contributions by volunteer ground stations will depend upon the existence of an effective communications network keeping monitoring stations current with Shuttle and satellite operations. Prospective monitors should, in the meantime, develop capability to hear and record whistlers -- and this includes finding suitable quiet sites for monitoring. I appreciate that this is a tall order, probably far removed from most readers' idea of pleasurable activity -- but its what I'm working on, and I'll be happy help those interested however I can.

CW BEACON SIGNAL GRABBER

D.E. Johnson June 1990



The "Beacon Grabber" is an accessory to a longwave receiver which allows detection of CW or tone-modulated Morse code repeating ident beacons under S/N conditions too poor for detection by ear. Under the worst conditions that it is capable of handling, it will indicate the presence of a carrier on the assigned frequency, but will not verify the ident in any way. Under slightly better conditions, when the operator has adjusted the clock rate so that the length of time required for data to propagate through the shift register equals the duration of one ident cycle, the "Grabber" will indicate the presence of modulation having that particular repeat rate-- not a positive ID, but pretty good if you know the ident repeat rate of the beacon you are trying to log. Under better conditions, but still about 6-9 dB worse than would be possible by conventional means, it will reconstruct the actual Morse code ident.

A few technical notes: Design of the synchronous demodulator/PLL is surely the most difficult task in building the Grabber. In comparison, the other stuff is a piece of cake. The threshold comparator has a tracking threshold so that the duty cycle of its output will be 50% in the long term, regardless of whether or not a valid signal is present. The shift registers should be large enough to code a complete ident cycle-- at least 64 stages: for instance CD4031 or CD4517. The adjustable clock must be capable of being set precisely, preferably within 1 bit of the shift register length. The correlation detector is an XNOR, or an XOR followed by an inverter. The voting circuit can consist of digital logic, or three equal-weight resistors driving the positive input of a comparator, the negative input of which is referenced to half the supply voltage. It gates the beeper on or off. The low pass filters have long, and preferably adjustable time-constants-- say 10 seconds or longer. Correlation and/or Morse code reconstruction can be improved by adding more shift register stages (and more complicated correlation and voting logic); however, this demands greater precision from the adjustable clock. If you're feeling extravagant, you can use a hardware correlator chip (TRW, Micro Devices) to get quicker correlation, especially on signals with unknown ident repeat rates. And you computer geeks have already figured out that this whole thing could be done in software.

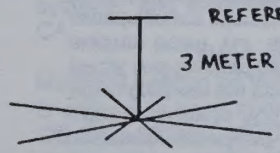
I have not yet built one of these gadgets.

MF RADIAL EXPERIMENTS ON 1648.5 KHz

DRY GROUND SANDY SOIL

GROUND-PLANE TYPE RADIALS

TODD ROBERTS
WD4NGG

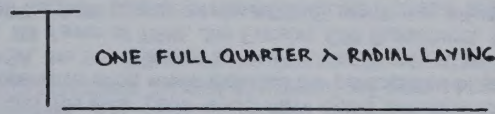


REFERENCE SYSTEM

3 METER VERTICAL W/TOPHAT

XMTR INPUT 100 mw
30 ma ANT. CURRENT

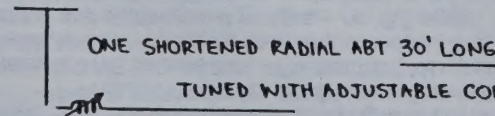
EXTENSIVE GROUND RADIAL SYSTEM (3000'+ OF WIRE)



ONE FULL QUARTER λ RADIAL LAYING ON GROUND (INSULATED WIRE) 140'

HAD TO BE SHORTENED TO 110' TO RESONATE

VERY INEFFECTIVE COULD NOT LOAD ANYWHERE NEAR 100 mw INPUT

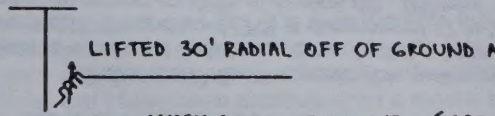


ONE SHORTENED RADIAL ABT 30' LONG LAYING ON GROUND (INSULATED)

TUNED WITH ADJUSTABLE COIL

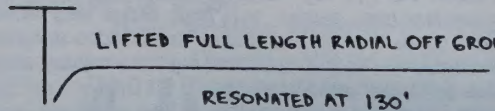
DREW MUCH MORE CURRENT THAN 110' RADIAL

COULD LOAD XMTR UP TO 100 mw INPUT. (ABT 10 ma ANT. CURRENT)



LIFTED 30' RADIAL OFF OF GROUND ABOUT 5'

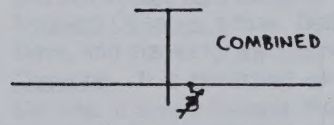
MUCH MORE EFFECTIVE (ABT. 20 ma ANT. CURRENT @ 100 mw)



LIFTED FULL LENGTH RADIAL OFF GROUND ABOUT 5'

RESONATED AT 130'

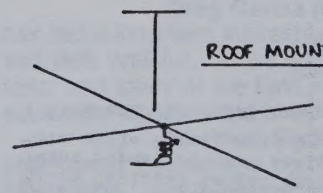
BETTER BUT STILL INEFFECTIVE COULD NOT LOAD UP TO 100 mw



COMBINED 2 ELEVATED 30' RADIALS 5' ABOVE GROUND

TUNED WITH SINGLE ADJUSTABLE COIL

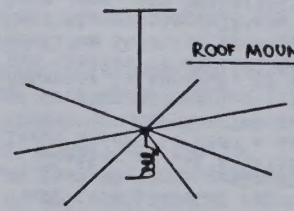
OUTPERFORMED EXTENSIVE GROUND RADIAL SYSTEM (35 ma ANT CURRENT @ 100 mw)



ROOF MOUNTED 3 METER VERTICAL

4 - 30' ELEVATED RADIALS ABOUT 15' ABOVE GROUND

TUNED WITH SINGLE COIL (40+ ma ANT CURRENT)



ROOF MOUNTED VERTICAL

INCREASED NUMBER OF 30' RADIALS TO 7

50 ma ANT CURRENT

CONCLUSIONS :

SHORT 30' TUNED RADIALS DREW MUCH MORE CURRENT INTO 3 METER ANTENNA THAN FULL 1/4 λ RADIALS

ALLOWING RADIAL WIRES TO SAG NEAR OR LAY ON GROUND RUINED THEIR PERFORMANCE. EVEN THOUGH THEY COULD BE RE-TUNED TO RESONANCE, THEIR CLOSE PROXIMITY TO GROUND SEEMED TO SWAMP OUT MOST RETURN CURRENTS.

A MODEST ELEVATED WIRE TUNED RADIAL SYSTEM GREATLY OUTPERFORMED AN EXTENSIVE GROUNDED RADIAL SYSTEM OF OVER 3000'+ WIRES.

To: Jim Ericson, Editor, Western Update Newsletter:

Here is a copy of a letter I sent to Dave Curry this morning. He has asked me for comments on antenna loading variometer designs. I Thought maybe some part of it might be of some interest for a future Update.

73, Ed Phillips W6IZJ/ LowFER IZJ

408 North Alabama Street
San Gabriel, California 91775
May 27, 1990

Editor's note: Thanks for sharing your letter with the readers! Just for info I might mention that you furnished this to me on Macintosh computer disc , using Microsoft Word v4.0, and MacDraw/Draft for the graphics (a first!). I did the editing on my Mac, and it saved me a lot of time. I edited the letter 'lightly', and the graphics -- not at all. The reason for the coil form and wire sizes shown is that Dave apparently has 4", 6" and 8" coil forms, and he has a "bunch" of #20 and #22 magnet wire available.

Dear Dave:

I've run off some calculations on possible variometers for you, based on the information you gave me on the 30 foot mast with 6 foot diameter top loading "hoop". I estimate that its total capacitance is about 146 uufd. In order to get a design of a little more general use I have assumed that the minimum capacitance anyone would want to tune would be about 120 uufd, corresponding to a 40 foot tower with no top loading; this would take 8250 uH of inductance at 190 kHz and 5817 uH at 160 kHz. The probable maximum capacitance for a large antenna would be 300 uufd which would take 2339 uH at 190 kHz. Based on this I will give you four possible variometer designs which will give the maximum inductance of about 8500 uH, and then discuss what might be best for antennas with more capacitance and thus requiring less inductance.

At this point I should mention that a variometer with rotating coil is a convenience, but definitely not as low loss as a straight solenoid with turns pruned to give the required inductance; and will have the minimum RF resistance for any given diameter and wire size, and thus will be the most efficient. A better design, but one requiring a much better initial knowledge of the exact antenna capacitance and intended operation frequency, would involve a large straight solenoid in series with a much smaller coil at one end, which could be rotated (or slid in and out) to give the desired value for resonance.

In the first two tables (see figures 1 and 3) I am assuming the inner coil is mounted on a 1/4" diameter shaft, with windings on both the inner and outer coils equally spaced on each side of the shaft, and wound as close to it as possible. This design puts the inner coil in the center of the outer one and gives the largest inductance change but has more loss than the second one which I will discuss. The min, mid, and max inductance values correspond to the case where the inner coil is turned so the mutual inductances buck each other, the case where the coil is at right angles and neither aids nor bucks, and the case where the coil is turned so the inductances aid each other. The Q values and the AC resistance are given for 175 kHz (mid-band), and are probably optimistically high for the Q and low for the resistance. These first designs would probably work best where the loading coil is connected to some sort of matching network, as the coupling to a third (tank) coil would vary a lot as the inductance is varied, and it might be tough to get enough coupling at low inductance values.

	D (in)	L(in)	N	BS #	L (feet)	Weight (#)
Large coil:	6	6.75	225	22	355	.70
Small coil:	4	3.75	125	22	132	.26

L min (uH):	3465	Q:	218
L mid (uH):	5983	Q:	378
Lmax (uh):	8501	Q:	537
AC resistance (ohms):	17.4		

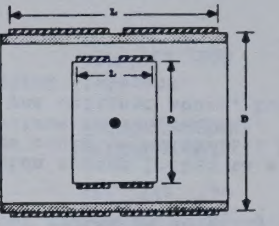
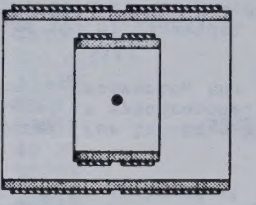


Figure 1. Inner coil at center (max inductance change).

	D (in)	L(in)	N	BS #	L (feet)	Weight (#)
Large coil:	8	5.25	139	20	294	.92
Small coil:	6	4.5	120	20	190	.60

L min (uH):	2064	Q:	130
L mid (uH):	5306	Q:	335
Lmax (uH):	8548	Q:	540
AC resistance (ohms):	13.3		



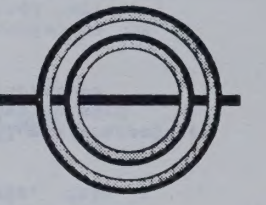


Figure 3. Details of coils and shaft.

In the next two designs, which I recommend for lower losses, the inner coil is mounted at one end of the outer coil, with the shaft as close to it as possible (see figure 2). The inner coil is wound as above, but the outer coil is a continuous winding. While the total inductance range is less than before, the AC resistance is only slightly higher and inductive coupling to a tank coil would be much easier. These are the designs I would select if I were building a new station:

	D (in)	L(in)	N	BS #	L (feet)	Weight (#)
Large coil:	6	8.00	267	22	421	.83
Small coil:	4	3.75	125	22	132	.26

L min (uH:	5687	Q:	315
L mid (uH):	7173	Q:	398
Lmax (uH):	8659	Q:	480
AC resistance (ohms):	19.8		

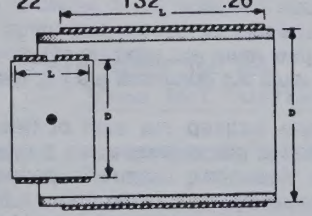


Figure 2. Inner coil at end (lowest loss).

	D (in)	L(in)	N	BS #	L (ft)	Weight (#)
Large coil:	8	6	160	20	337	1.06
Small coil:	6	4.5	120	20	190	.60

L min (uH):	3764	Q:	287
L mid (uH):	6084	Q:	464
Lmax (uH):	8404	Q:	641
AC resistance (ohms):	14.4		

You will notice that for all designs the Q drops rapidly as you go toward minimum inductance, since the AC resistance of the coils is about the same but the inductance (and hence the reactance) are falling off. For this reason, once the coil is found to resonate it would be desirable to take turns off the ends of the outer coil until resonance is obtained with the inner coil turned well past the mid-inductance point, leaving only enough turns to ensure a reasonable tuning range. Doing this will result in the least loss for any installation, and hence the maximum radiated power.

If I were building a coil I would use the smaller wire size and coil diameters, since the maximum AC resistance for any of these designs is probably quite a bit less than the effective resistance of the antenna and ground of almost any installation without a massive ground radial/counterpoise system. (Here at IZJ the effective resistance of the antenna/trees/ground is about 60 ohms!) Once I had the station tuned up and running (an RF ammeter, even if only of the rectifier type I described in one of the Updates, is almost essential for tuning) I'd consider making a bigger coil, probably a solenoid with a small "variometer coil" at one end, with a very limited tuning range.

If you have any further questions drop me a line and I'll try to help as time permits.

73, Ed Phillips

A NEWFANGLED SYNCHRONOUS COMMUNICATIONS SCHEME D. E. Johnson June 1990

This scheme provides synchronous spread-spectrum communication in the longwave region, between sites that are preferably located within a fraction of a wavelength of each other.

First, choose a frequency that is low enough that the transmitting and receiving sites will lie within a fraction of a wavelength of each other. (For instance, say the sites are 5 miles apart, and the communications frequency chosen is 3 kHz, with a wavelength of about 60 miles.)

Now install at each site a (matched) receiving system tuned to half the communications frequency (1.5 kHz in the example). These matched receiving systems receive atmospheric noise over some finite bandwidth, say 200 Hz. Since they are located fairly close to each other, they receive essentially the same noise signals. These noise signals are run through a frequency doubler and filtered to a bandwidth of 400 Hz centered at 3 kHz. This is the frequency/phase reference.

The frequency/phase reference is modulated (for instance BPSK) and transmitted. At the receiving site, the received signal is synchronously demodulated using the local frequency/phase reference, recovering the information embedded in the signal.

Other signals that may be present in the 400 Hz bandwidth occupied by the communications channel, such as atmospheric noise or unmodulated carriers, will be converted to broadband noise upon downconversion. If the baud rate is at least an order or two of magnitude less than 800 baud, then most of the noise can be eliminated by low pass filtering or by an integrate-and-dump filter.

The requirement that the sites lie within a fraction of a wavelength of each other can be relaxed somewhat by providing directional phase reference antennas and compensating for phase differences resulting from the difference in location.

I can't imagine what on earth this communications system is actually useful for. Can you?

P.S. In a medium frequency coherent communication system locked to a narrowband reference such as WWVB, the reference could be multiplied by VLF/ELF atmospheric noise to achieve spread-spectrum communications. Such a system is far more complicated than the one outlined above, but it could be used for communication over substantial distances.

Aldrich	Daniel			8030 Petit Verdot Court	Sacramento	CA	95829	
Anderson	Brice	BA	W9PNE	PO Box 14	Lancaster	IL	62855	(618)299-2441
Armstrong	Lloyd			3813 Lancaster Drive	Pueblo	CO	81005-3065	
Ashley	Lynn			2401 N. Vernon St.	Arlington	VA	22207	(703)522-5308
Bahr	Leland	LEE	WØVT	914 Golden Bear Lane	Kingwood	TX	77339-2914	(713)359-5284
Balfour	Herb	OHH	VE3OHH	91 Elgin Mills Road West	Richmond Hill (Canada)	ONT	L4C4M1	(416)884-5355
Barlow	Ron	A	N4GJV	14245 Cool Springs Road	Cleveland	NC	27013	
Bauer	Frank	FB	W6FPO	PO Box 1086	Felton	CA	95018	(408)335-7392
Bittner	Mike			27215 Sunnyridge Road	Palos Verdes	CA	90274	
Bond	Robert		WD6BCN	1420 McLoughlin Avenue	Oxnard	CA	93035	(805)985-0159
Borglum	James			5549 Lesa Road	La Mesa	CA	92041	(619)464-3250
Bowers	William			Rt. 3, Box 177 AC	Chandler	OK	74834	(916)377-4237
Bradley	Dave		W6CUB	PO Box 2043	Freedom	CA	95019-2043	
Bumpus	Carle			930 Idylberry Road	San Rafael	CA	94903	
Burhans	Ralph			161 Grosvenor Street	Athens	OH	45701	(614)593-8207
Burr	David			505 Mackenzie Drive	Lima	OH	45805	
Buttschardt	Cliff	HDO, C	W6HDO	950 Pacific Street	Morro Bay	CA	93442-2327	(805)772-2132
Carter	Max	X, MAX		46 - 14th Street	Wheatland	WY	82201	(307)322-9439
Cathell	Frank	H2, SD	K3YAZ	PO Box 535	Descanso	CA	92016	(619)445-8167
Chalmers	Doug			450 Adobe Place	Palo Alto	CA	94306	
Chappell	Vernon			4511 - 36th Street #6	San Diego	CA	92116	
Coote	James	J	WB6AAM	808 North Ave. 66	Los Angeles	CA	90042	(213)258-7490
Confrey	Bob		WA1EDJ/4	3391 Border Drive	Stone Mountain	GA	30087	
Cornell	Ken		W2IMB	225 Baltimore Avenue	Pt. Pleasant Beach	NJ	08742	
Costa	Bob		KB6QXM	P.O. Box 600	Redwood Estates	CA	95044	(408)353-3656
Curry	David	PLI	WD4PLI	852 N. Lima Street	Burbank	CA	91505	(818)846-0617
Cutter	Robert	CO	KIØG	701 19th Street	Glenwood Springs	CO	81601	
DeVaughn	Bob	NBD	K3NBD	829 Estella Street	Pittsburgh	PA	15210	(412)488-1479
Dorman	Mike			15635 21st Ave. SW	Seattle	WA	98166	(206)246-3796
Edwards	Bill			PO 1229	Cowpens	SC	29330	
Egleston	Allan			20601 Resort Road	Sonora	CA	95370	(209)532-7111
Ericson	Jim	EK	KG6EK	226 Charles Street	Sunnyvale	CA	94086-6063	(408)773-8947
Farkas	Greg	AZ	AK7Y	PO Box 17074	Tucson	AZ	85731-7074	(602)749-4796
Farnsworth	Charles			506 Rutledge Drive	Lodi	CA	95240	
Faulkner	Charles	FPV	W6FPV	15844 McKeever	Granada Hills	CA	91344	(818)366-6210
Fisher	Montie		WA5TSL	808 Brett Drive	Edmond	OK	73013	
Fornek	Stan		K9IXC	640A Rance Road	Oswego	IL	60543	
Garcia	Greg		WD6DAI	P.O. Box 170626	San Francisco	CA	94117	
Gelinas	Ed	T (dashes)	WA6AJY	557 N. Bayview	Sunnyvale	CA	94086	
Gosenca	Michael			203 Cherry St.	Eaton Rapids	MI	48827	
Grater	Jim			1136 S. Johnson St.	Lakewood	CO	80226-5113	
Griffith	Anthony			117 White St.	McMinnville	TN	37110	
Harrington	J. Patrick			4603 Riverdale Road	Riverdale	MD	20737	
Hedspeth	Scott	N3S	WB4YZA	Route 4, Box 227	Mocksville	NC	27028	(704)284-4021
Helms	Bernard			4210-1 Walnut	Berrien Springs	MI	49103	
Herr	George			6690 Vista Del Mar #1	Playa Del Rey	CA	90293	
Holland	David	DCH	K3YAY	300 South Main Street	Berlin	MD	21811	
Hooper	William		KF6AR	366 S. El Monte Road	Los Altos	CA	94022	
Hoopes	John			1084-B Sergeants Drive	Robins AFB	GA	31098	
Johnson	Dave		WA4NID	PO Box 389	Gainesville	FL	32602	
Johnson	Dave	F, DJ		713 Texas Ave.	Los Banos	CA	93635	(209)826-0841
Johnson	Don	AU	W9TIF	3304 Roxford	Champaign	IL	61821	(217)398-4020
Jones	Ron		K7RJ	9241 S. Toni Lee Circle	West Jordan	UT	84088	(801)561-2685
Jones	Wallie	WJ	W6SZQ	9090 Nagle Ave.	Arleta	CA	91331	(818)892-0552
Kassel	Charles			114 Church Drive	Mastic Beach	NY	11951	
Keeley	Roy		KC4IMC	10675 Salt Air Road	Theodore	AL	36582	(205)973-2516
Keller	Eb			2984 Fallwood Lane	San Jose	CA	95132	(408)263-6229
Kincaid	Nilan		W6EIG	5529 W. 140th Street	Hawthorne	CA	90250	(213)643-5269
Kraus	Howard		K2UD	372 Callodine Avenue	Amherst	NY	14226-2971	(716)838-2406
LaGrua	Michael			Box 549	Caspran	MI	49915-0549	
Layer	Hal		N6SPD	PO Box 27676	San Francisco	CA	94127	(415)661-6958
Lee	Mitchell	MEL	KB6FPW	172 North 24th Street	San Jose	CA	95116	(408)298-3026
Leonardelli	John		VE3IPS	Box 722, Station A	Downsview (Canada)	ONT	M3M3A9	(416)636-3300
Lingwall	John			PO 70, 1025 Trinidad	Calhan	CO	80808	

Mallory	Mark	MPM, D, U	WB7CAK	5196 Cobblecreek Road #7K	Salt Lake City	UT	84117
Manley	Dean		KH6B	2058 Ainaola Drive	Hilo	HI	96720-3638 (808)959-8257
Marshall	Dave			440 Larry Drive	Florissant	MO	63033
Martin	Steve		NK3R	141 Bridgecreek Drive	Goose Creek	SC	29445 (803)797-3143
Mawhinney	Scott	T (dashes)		295 Pettis Avenue	Mountain View	CA	94041 (415)960-1041
Maxwell	James		W6CF	PO Box 473	Redwood Estates	CA	95044 (408)353-2094
McGreevy	Steve	RR, ER	N6NKS	45 Elda Drive	San Rafael	CA	94903 (415)479-4259
Midcke	Mike	Z2	WB6EER	Box 123	San Simeon	CA	93452-0123
Morgan	Robert			2817 West St. Anne	Rapid City	SD	57702
Mozzochi	C.J.			PO 60	S. Glastonbury	CT	06073
Mussler	Mike			Bonanza Star Route	Nederland	CO	80466
Norman	Charles			4938 Spirit Court	Stone Mountain	GA	30087
Olson	Keith	7FS	W7FS	E. 15470 Highway 106	Belfair	WA	98528 (206)275-2560
Otacilio P. de Sousa	José			Rua Calisto 62, Recanto dos Vinhais	São Luis, MA, Brasil	PR8BNP	65070
Owens	James	Q	NWØ0	1363 Tipperary	Boulder	CO	80303
Palermo	George			1444 First Street, Suite A	Sarasota	FL	34236 (813)365-7777
Paschal	Ev			Sinclair Island	Anacortes	WA	98221
Pepe	Bill		WA2TDR	Box 1915	Bloomfield	NJ	07003
Peterson	Art			851 31st Street	Richmond	CA	94804 (415)234-2014
Phillips	Ed	IZJ	W6IZJ	408 North Alabama Street	San Gabriel	CA	91775 (818)285-8308
Pomplun	Don		K2BIO	521 Van Buren Place	San Ramon	CA	94583 (415)829-7648
Post	Kendall			1842 Hoffman Street	Madison	WI	53704 (608)244-0500
Raney	David	CAT	WC8E	4128 Linden Avenue	Cincinnati	OH	45236 (513)791-0740
Rappold	Sam	ZYK	WB6ZYK	PO 1267/479 Briceland Road	Redway	CA	95560
Ratzlaff	Steve	SR	AA7U	295 Pettis Ave.	Mountain View	CA	94041 (415)965-7623
Rausch	Bill		AA6PA	820 Warren Way	Palo Alto	CA	94303-3627 (415)327-4662
Raven	Gregory	TEXAS	KF5N	4550 Sunnybank Court	Fort Worth	TX	76137 (817)485-6771
Reid	Frank		W9MKV	Box 5283	Bloomington	IN	47407-5283
Remington	Sheldon	HO	NI6E	PO Box 2094	Pahoa	HI	96778 (808)966-6946
Roberts	Todd	ABC	WD4NGG	PO Box 21413	Hilton Head Island	SC	29925 (803)681-8114
Schick	D.H.			580 N. Buena Vista Dr.	Lake Alfred	FL	33850
Schilke	John		AH8AC	184 Harding Blvd.	Oregon City	OR	97045 (503)656-9216
Seabury	Tom			PO 535	Diablo	CO	94528
Seamons	John	JKS	KF6VO	95 Holstein Road	San Anselmo	CA	94960 (415)456-6090
Seden	Randy	ELU, U	WD6ELU	1272 Harold Avenue	Simi Valley	CA	93065 (805)583-5687
Shirley	Larry			20 Third Avenue	Huntington Station	NY	11746
Skillin	Boyd	MGX	K6MGX	3876 East Pico	Fresno	CA	93726 (209)222-0275
Snow	John		N6AMZ	3708 Judah Street	San Francisco	CA	94122-1227
Spaulding	Fred		K1YQP	883 San Simeon Drive	Mountain View	CA	94043 (415)961-5018
Spencer	Chris	FAW	WB7FAW	722 West 1850th North	Orem	UT	84057 (801)225-7852
St. Angelo	Michael		N2MS	61-16 80th Avenue	Glendale	NY	11385
Statom	Mike			7401 MUNSS Box 45	APO NY	NY	09670 (818)289-7170
Stewart	Don			2617 Anza Street	Bakersfield	CA	93305-3109 (805)871-7024
Stinson	Dave	R	AB5S/7	HCR 65, Box 71053	Pahrump	NV	89041 (702)727-4370
Strong	David			4231 E. Grove Street	Phoenix	AZ	85040 (602)437-1694
Sullivan	John			2069 Touraine Lane	Half Moon Bay	CA	94019
Taylor	Bill			327 Camino Del Campo	Redondo Beach	CA	90277 (213)378-5628
Thompson	Arliss	XU	W7XU	Route 1, Box 52	Colton	SD	57018 (605)446-3687
Tracy	John			10431 Miller Avenue	Cupertino	CA	95014
Trinkaus	George			4326 S.E. Woodstock, #489	Portland	OR	97206
Turner	Clint	CT	KA7OEI	145 West Street	Pleasant Gap	PA	16823 (814)359-2663
Vanderbeek	Herb	G4	WY6G	630 Ashton Avenue	Palo Alto	CA	94306 (415)493-1726
Vandermaaten	Jim	SM	WB6QZL	1276 Tourney Drive	San Jose	CA	95131 (408)258-6872
Weiss	Jim		W9ZMV	c/o Radio WTAQ	LaGrange	IL	60525 (312)579-9104
Welch	James		KK6N	3071 Mauricia Avenue	Santa Clara	CA	95051
Wilson	Rex	TI	KB7TI	4550 Vernetti Lane	Kingman	AZ	86401 (602)757-3649
Wisniewski	Wit			1421 N. Sarnoff Drive	Tucson	AZ	85715 (602)721-8412
Wright	Rick	1SUN	KA5YWH	Box 4181, Station A, SEOSU	Durant	OK	74701 (405)924-3699
Wu	Milt			Box 308	Columbus	NM	88029 (505)531-2565
Wyatt	Frank		N6FW	855 Ticonderoga Drive	Sunnyvale	CA	94087 (408)737-8155
Zenick	Ray		K6RRP	444 S. Nardo Avenue	Solana Beach	CA	92075 (619)481-8469